gital Video Systems Developmen (DVSD)

PM ITTS STOC Industry Conference

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Presenters:

Name: Vic Krepacki
Org: PM ITTS IMO
E-Mail: krepackv@stricom.army.mil
Phone: 407.384.5272

Name: Gilbert Harding
Org: WSMR TT
E-Mail: hardingg@wsmr.army.mil
Phone: 505.678.1368

Description

- **OSD CTEIP funded project that will enable the full integration of digital image acquisition, transmission, storage and analysis systems into both air and ground based T&E environments**
- **Project's development divided into <u>three</u> distinct categories to satisfy multi-service requirements:**
  - **Digital image generation/acquisition (VIS, IR)**
  - **Data transmission/storage/archival**
  - **Data/Image analysis/conversion/editing**

Description

- **Project will have service lead for each category/segment of system development:**
  - **Digital Image Generation - Na**
  - **Data Transmission/Storage - ...ry**
  - **Image Analysis/Processing - ...AF**

Background

- **Designed to leverage and extend the performance envelope of products designed under three previous CTEIP funded programs (FY 95-01):**
  - **Airborne Separation Video (ASV) Navy**
  - **High Speed Massive Memory (HSMM) Army**
  - **Digital Video Laboratory (DVL) USAF**
- **Officially designated as an OSD CTEIP "New Start" program for FY 02**

Team Approach

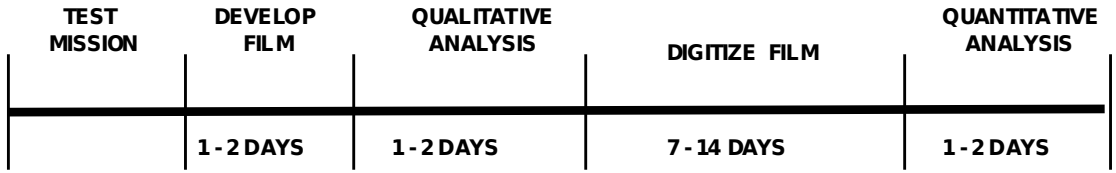
- **Assess Existing Technology Base**
- **Assess Current Implementations**
- **Sponsor New Developments [as required]**
- **Sponsor Upgrades and Augmentations**
- **Incrementally Build/Integrate/Field Capabilities Into System Configuration**
- **Modify Test Techniques/Procedures and Migrate into Range Ops**

Objective

- **ELIMINATION OF PHOTOLAB**
  - **Environmental Concerns and Infrastructure**
  - **Reduce Personnel & Increase Environmental Comp**
  - **Film Cost, Development, Storage, and Disposal**
- **REDUCE MAN HOURS FOR DATA REDUCTION**
- **REMOTE CONTROL TRACKING SYSTEMS**
  - **Increased Efficiency**
  - **Eliminate Off Site Personnel Infrastructure**
- **INCREASE TEST EFFICIENCY**
  - **Multiple Test Points Per Flight/Test Mission**
  - **Ensure Quality Data Collection**
- **DECREASE TEST SCHEDULE LENGTH**
  - **Increase Tests Supported**
- **DEVELOP DIGITAL VIDEO TOOL DATABASE**

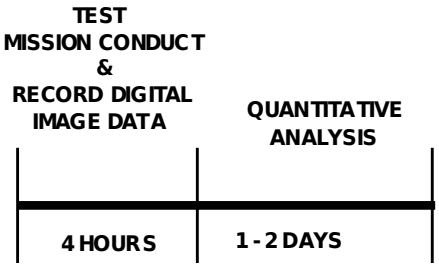
Objective

- **TEST MISSION TIMELINE USING FILM CAMERAS:**



(TOTAL: 10 - 20 DAYS)

- **TEST MISSION TIMELINE USING DIGITAL CAMERAS:**



(TOTAL: 1 - 2 DAYS WORST CASE)

Airborne Separation Video (ASV)

Background

ORIGINAL REQUIREMENT:

"LACK OF AN ACCEPTABLE REPLACEMENT FOR 16, 35, AND 70 MM HIGH SPEED FILM CAMERAS WHICH ARE USED FOR DATA COLLECTION AND ANALYSIS"

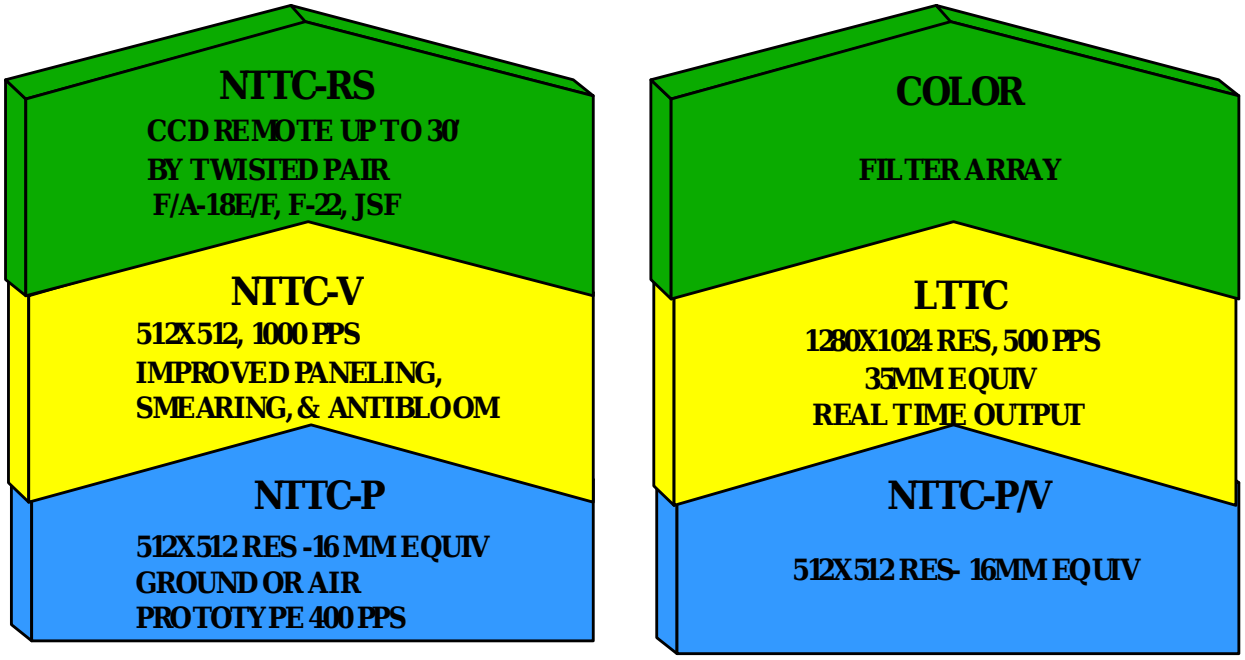
- **DRAWBACKS OF FILM CAMERAS**
  - NO PREVIEW CAPABILITY
  - FILM COST & DEVELOPING
  - DISPOSAL OF PROCESSING CHEMICALS - EPA
  - EXTENDS TURNAROUND
- **ADVANTAGES OF DIGITAL CAMERAS**
  - PREVIEW CAPABILITY
  - IMMEDIATE DATA FOR CUSTOMER
  - DECREASES RECURRING COSTS
  - ELIMINATES CHEMICAL DISPOSAL
  - IMPROVED ANALYSIS
  - SHORTER SCHEDULES

Airborne Separation Video (ASV)

- Effort to move from analog film to digital video to capture aircraft stores separation for the Navy
- Designed to replace 16/35mm film cameras in three phases:
  - NTTC-P
  - NTTC-V
  - LTTC (CMOS)
- NTTC: 512 x 512 CCD (Approx 16mm Equiv)
- LTTC: 1280 x 1024 CMOS (Approx 35mm Equiv)

Airborne Separation Video (ASV)

ASV Camera/Sensor Development

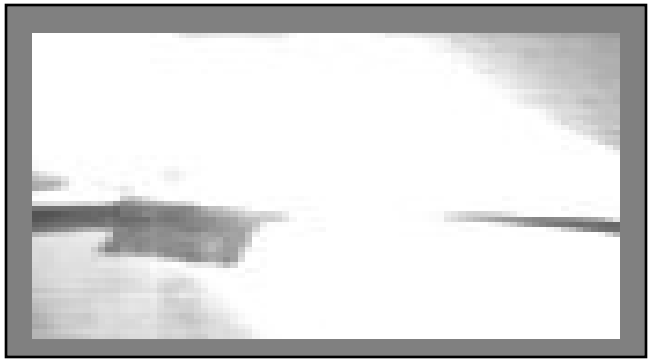


DECREASE SIZE = INCREASED USERS

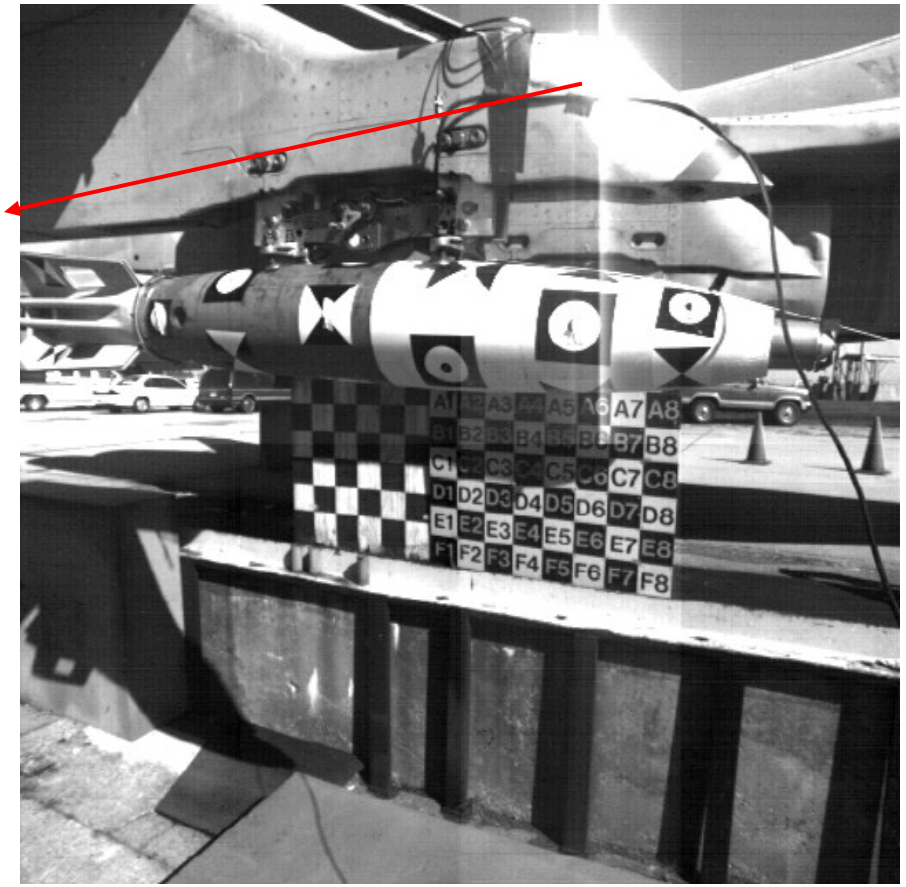
INCREASED RESOLUTION AND MEMORY

Airborne Separation Video (ASV)

Example Imagery from ASV NTTC - CCD



512 x 512 @ 500 fps



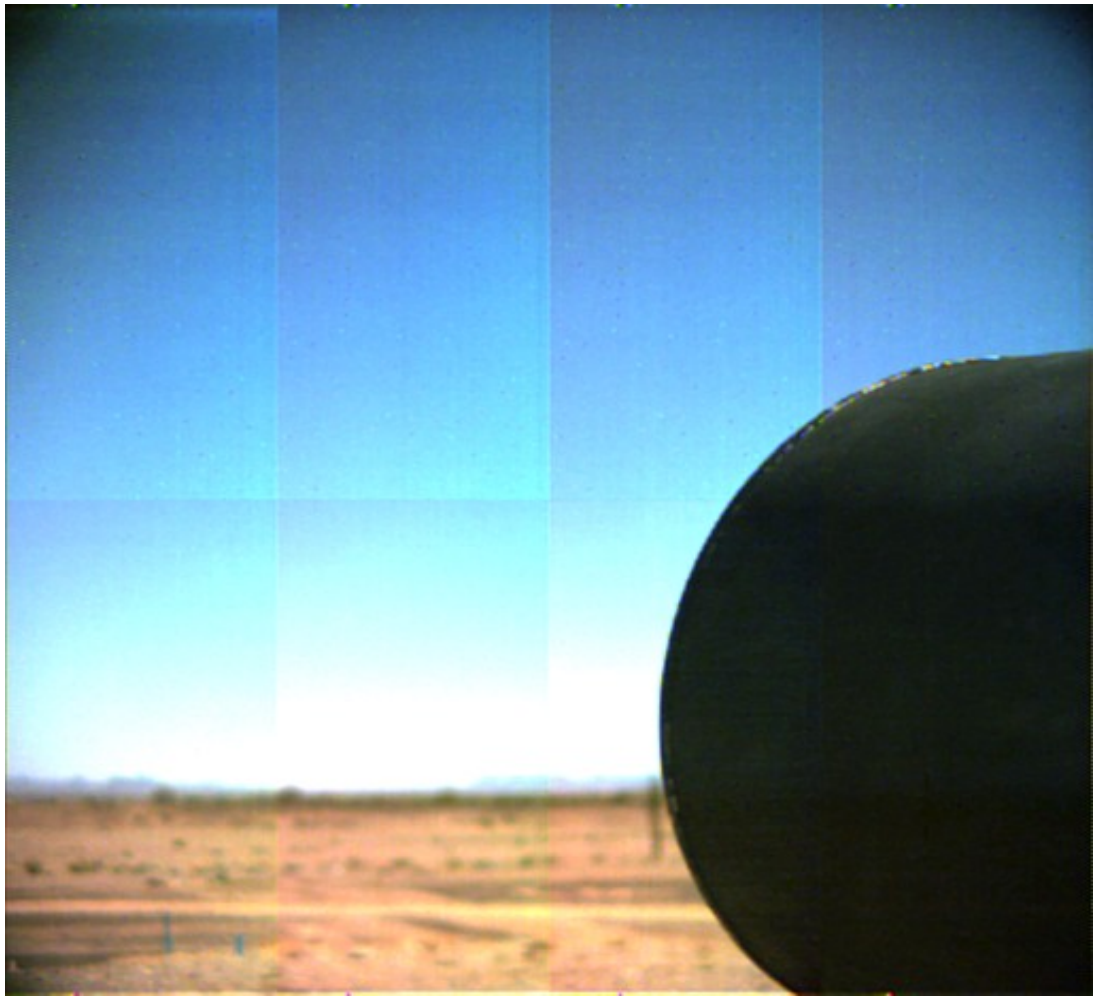
Airborne Separation Video (ASV)

F/A 18 E/F: NTTC-P VIDEO

NAWCAD Photogrammetrics
Airborne Separation Video Support

Airborne Separation Video (ASV)

YUMA ROCKET: NTTC-V VIDEO



Airborne Separation Video (ASV)

"ASV records F/A-18E Super Hornet's first release of Joint Direct Attack Munition (JDAM) MK84 version"

Digital Video Laboratory (DVL)

Background

- **Problem**
  - **Lack of Digital Video Technology Tools and Methods to Effectively Analyze, Archive, Access, and Transfer Digital Video and Associated Data**
  - **Digital Data Archiving, Access and Transfer Protocols/Stds Need to Be Determined**
- **Solution**
  - **Implement FY 01 Congressional Add - Established Digital Video Laboratory (DVL) Under AFSEO**
- **Additional Outcome**
  - **Integrate Results As Part of Technology Base for Follow-on CTEIP/Service Digital Video Efforts (DVSD)**

Digital Video Laboratory (DVL) Technical/Management Approach

- **Phase 1**
  - **Use the Air Force SEEK EAGLE Office (AFSEO) Stores Certification Process**
  - **Analyze the Process and Identify Areas that can be enhanced by the insertion of Digital Techniques/Tools**
  - **Provide feasibility study with recommendations, preliminary Cost Benefit Analysis**
  - **Effort completed 31 Mar 01**

Digital Video Laboratory (DVL)

Phase 2 - Tech/Mgmt Approach

- **Leverage Phase 1 Study Results**
- **Convert Selected Analog Test Data to Digital Data**
  - **Recommend Options to Continue Process**
- **Design and Deliver a Digital Multi-Media Management System (DMMS)**
  - **Capable of Archiving, Retrieving, and Analyzing Digital Data**
  - **Develop Digital Video Tool Set:**
    - **Image Stabilization/Orientation/Enhancement**
    - **"Spatiotemporal Tweening" Image Interpolation Techniques**
- **Integrate Selected Digital Video Analysis and Exploitation Tools into DMMS**
  - **Deliver DMMS S/W Tools to Each Service**
- **Recommend Joint Technology Plan for Airframe-Stores Certification Process**
  - **Army: Aviation Engrg Dir, Navy: NAWC-AD, AF: SEO**

Digital Video Laboratory (DVL) Schedule

PROGRAM

AFSEO TECH ASSESSMENT

- Independent tech team
- End-to-end processes
- User focused (all levels)

FY01 CTEIP DV PROGRAM

- TECH ASSESSMENTS USN (PAX), ARNOLD, USA(Huntsville)
- CTEIP MID-YR REVIEW

Vision & Insight

FY02 DV PLAN

PRODUCTS

- Plan
- Prototype (OTS)

DEMONSTRATIONS, PROTOTYPING

Concurrent Fielding & User Req'd Maturation

CAPABILITY INSERTION - DVSD

- Prototypes
- Off-the-shelf

High Speed Massive Memory (HSMM)

Background

- **Digital focal plane array technology spawned advent of high resolution single-frame/low-frame rate cameras**
- **High-speed concept (100-500fps) drove need for mass storage**
- **CTEIP approved HSMM in FY96 to develop data transfer/storage techniques, ASV to develop digital high-speed cameras**

High Speed Massive Memory (HSMM)

Description

- **High Density (512x512,1024x1024,1280x1024), high frame rate (up to 500 fps) Flexible Digital Image Camera Support**
- **Designed to Support Two Main Levels of Performance:**
  - **Entry-Level System (35-50 Mbytes/sec)**
  - **High-End System (50-1000 Mbytes/sec)**
- **Comprised of three primary components:**
  - **Digital Video Sensor**
  - **Mass Storage Device**
  - **Digital Image Data Reduction Workstation**
- **Supports RS-170/NTSC (Mono/Color) A/D Video Capture**
- **Ability to interface w/Networks (e.g., TSN) using**

High Speed Massive Memory (HSMM)

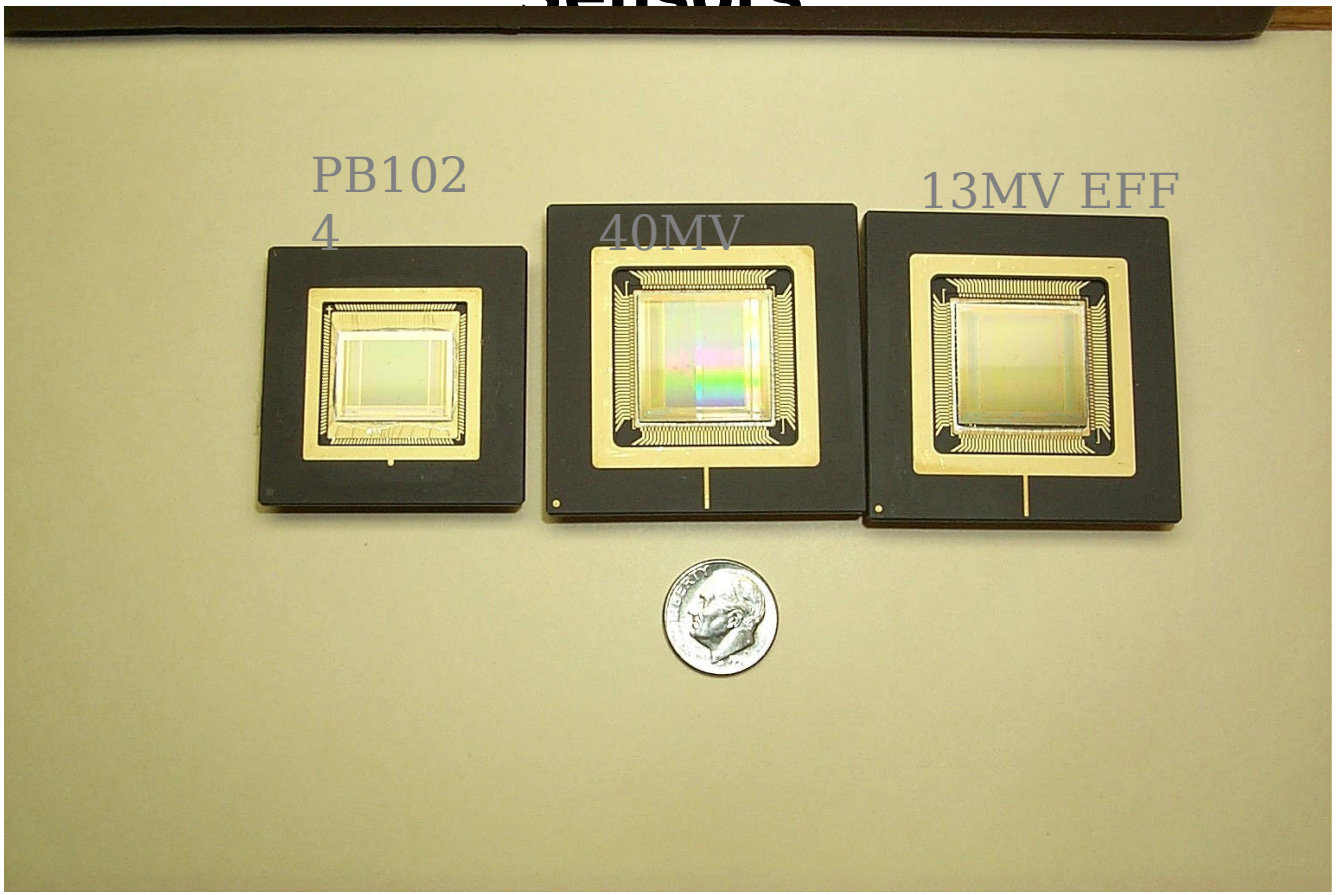
High Speed Massive Memory (HSMM)

HIGH END SYSTEM

- Real-Time Storage System (RTSS)
  - Up to 1 GByte/sec sustained recording rate
- Interface Converter (ICON) Module:
  - ASV LTTC Camera
  - UHR/HS SBIR Tech Demo Camera
- Modular design:
  - Min 600 sec recording time, expandable to 40 min
- VSR-192 interface
- DWDM compatible for long haul transmission
- Interface to Storage Area Network (Local, Mobile) for long term storage

Joint WSMR / ASV Effo

High Performance CMOS APS Sensors



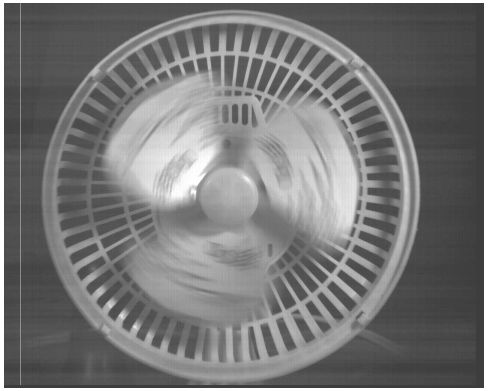
Joint WSMR / ASV Eff...

Sensor Specifications

	PB1024	MV40	MV13 EFF
Pixel Array	1024 x 1024	2368 x 1728	1280 x 1024
Pixel Pitch	10 µm	7 µm	12 µm
Frame Rate	500 fps	200 fps	500 fps
Digitization	8	10	10
Data Rate	**500MB/sec**	**1 GB/Sec**	**800 MB/sec**
QE/Fill Factor	35%	30%	35%
Shutter	Progressive	Progressive	Electronic Freeze Frame
ADCs	On chip	On chip	On chip

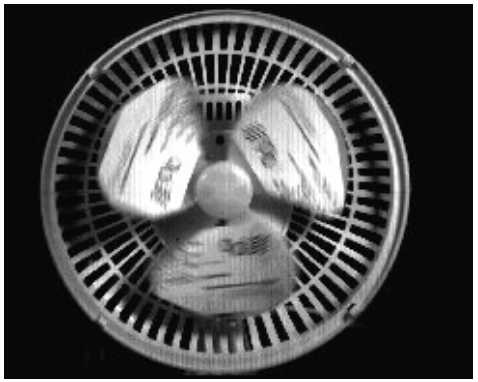
Example Imagery of MV13 Sensor - CMOS

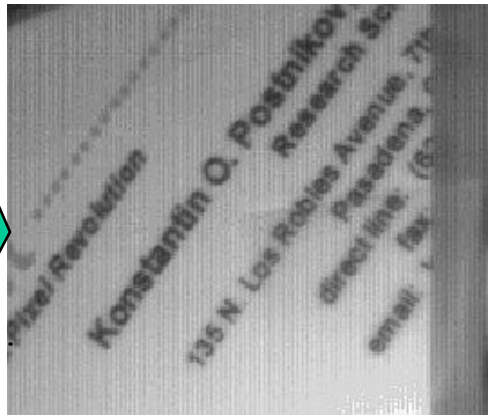
1650 micro-sec shutter



30 micro-sec shutter

800 micro-sec shutter

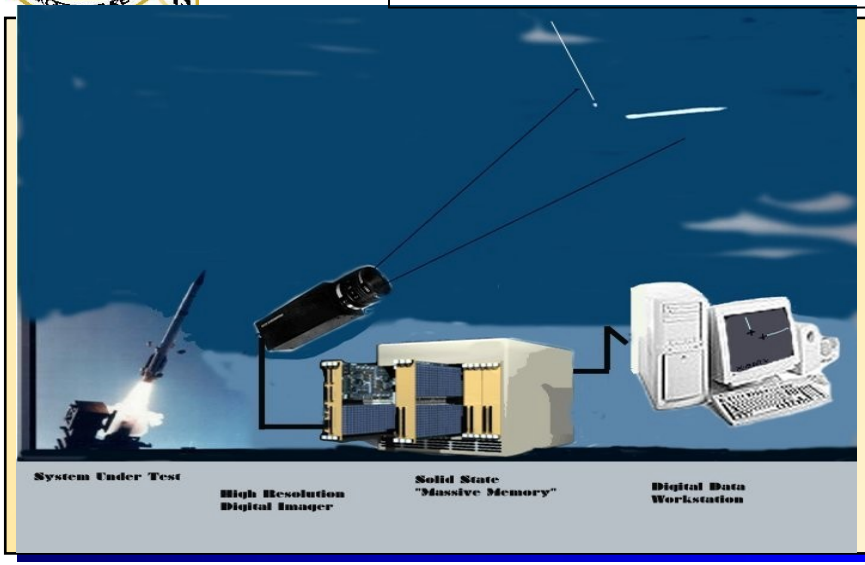




* **Fan Rotating at 1200 RPM**

Images Courtesy of Photobit Corporation

High Speed Massive Memory - DVSD



USERS / CUSTOMERS

- Customer - White Sands Missile Range (WSMR)
- Users -
  - •Army Tactical Missile System (ATACMS) (Army)
  - •Brilliant Anti-Armor Tactical (BAT) (Army)
  - •Multiple Launch Rocket System (MLRS) (Army)
  - •Theater High Altitude Area Defense (THAAD) (Army)
  - •Joint Standoff Weapon/ Joint Deep Attack Munition (AF)
  - •Advanced Medium Range Air-to-Air Missile (AMRAAM)
  - •TSTAR (BAT/Cruise Missile) Standard Missile (Navy)
  - •Roving Sands (Army)
  - •Entertainment Industry (Potential)

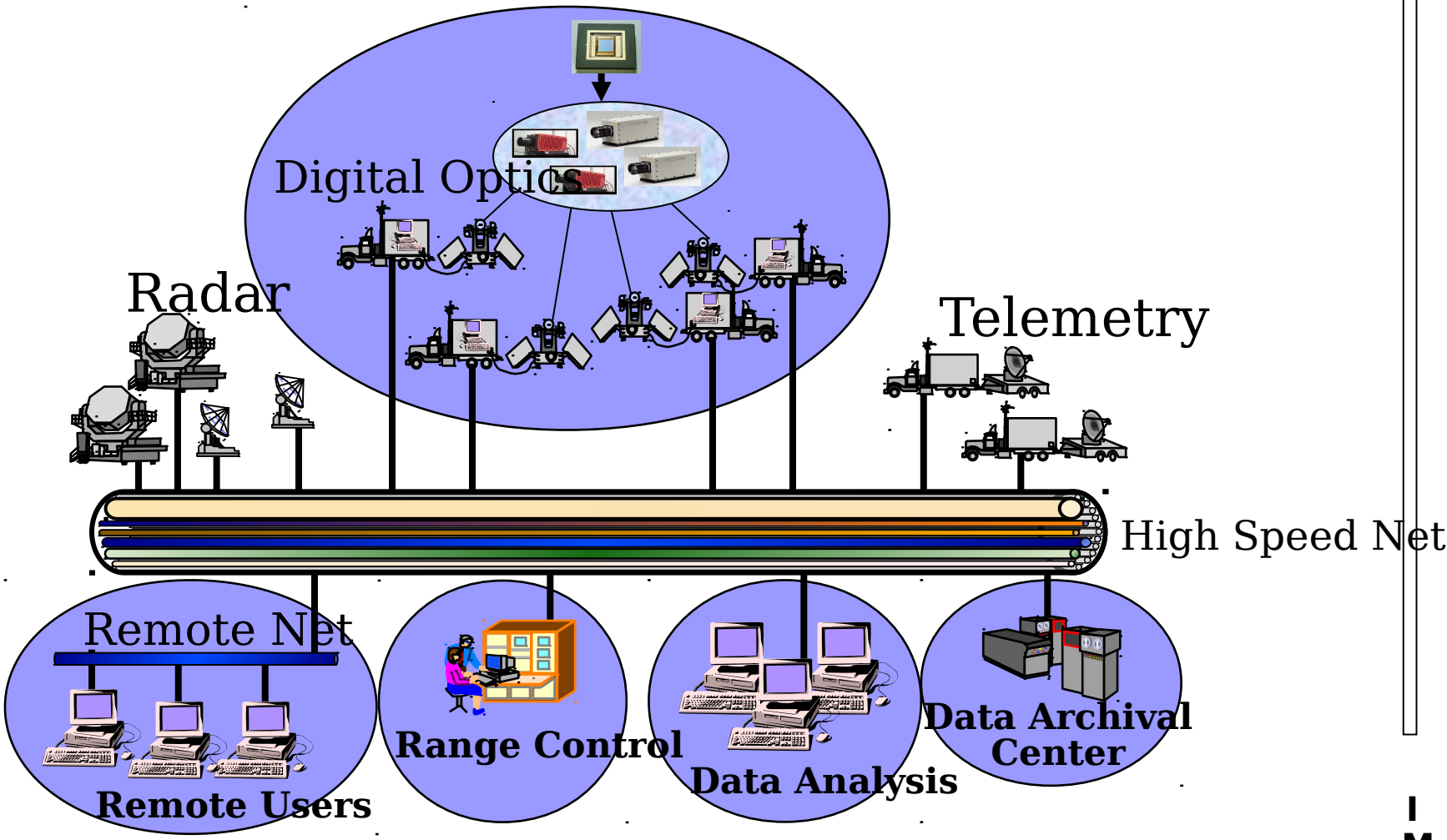
DESCRIPTION

- HSMM provides high speed, high capacity storage for data streams from high frame rate digital image devices in real time.
- HSMM Architecture composed of:
  - •Digital Image Device GFE (ASV or commercially purchased)
  - •Mass Digital Storage Device (RTSS)
  - •Very High Speed Links
  - •Data Reduction Workstation (SGI 540/NT or equivalent)
- HSMM Systems to be delivered 7-8 August

FUNCTIONAL/TECHNICAL DATA

- Leveraging technology from 2 separate programs: CTEIP Airborne Separation Video (ASV) (Navy) SBIR Phase I/II Complimentary Metal Oxide Semi-Conductor (CMOS) Chip Development (DTC)
- Provides scalable data transfer rates (35-50, 50-1000 Mb/s) and rapid data acquisition/reduction (< 1 hr)
- All levels achieved w/commensurate storage capacity (60 GB, 100 GB) scalable disk arrays
- Eliminates high speed motion picture film (in approximately 90% of the applications)

Conceptual DVSD Architecture



Digital Video Systems Development

PROGRAM TEAM

Project Director
Army/ STRICOM
Vic Krepacki
407 384-5272

Technical Director
Army/ WSMR
Tomas Chavez

Contract Specialist
Leslie Kennedy
407 380-4043

RCC OSG

DPM Air Force
46 TW Eglin AFB
Joe Rech
Data Reduction/Analysis

DPM Army
WSMR
Gilbert Harding
Data Systems/Transfer/Storage

DPM Navy
NAWC-AD
Chris Paust
Camera Systems

Acquisition/Contracting Strategy

- **Multiple Acquisitions via TO's (STRICOM), WAO's (Ranges)**
- **Competitive Awards (STOC, Other Contract Vehicles)**
- **System Integrator: Gov't Team w/SETA Support**
- **Development Cycle: FY 02-06**
- **Limited Competitive Environment (Technology Driven)**
- **Technology: VIS/IR Chipsets, DWDM/OC-192 Fiber Net, Distributed Storage, Commercial/Gov't DV Editing Tools**
- **Typical Vendor Base: Photobit, DRS, Sarnoff, Vision Research, PsiTech, Cisco Systems**

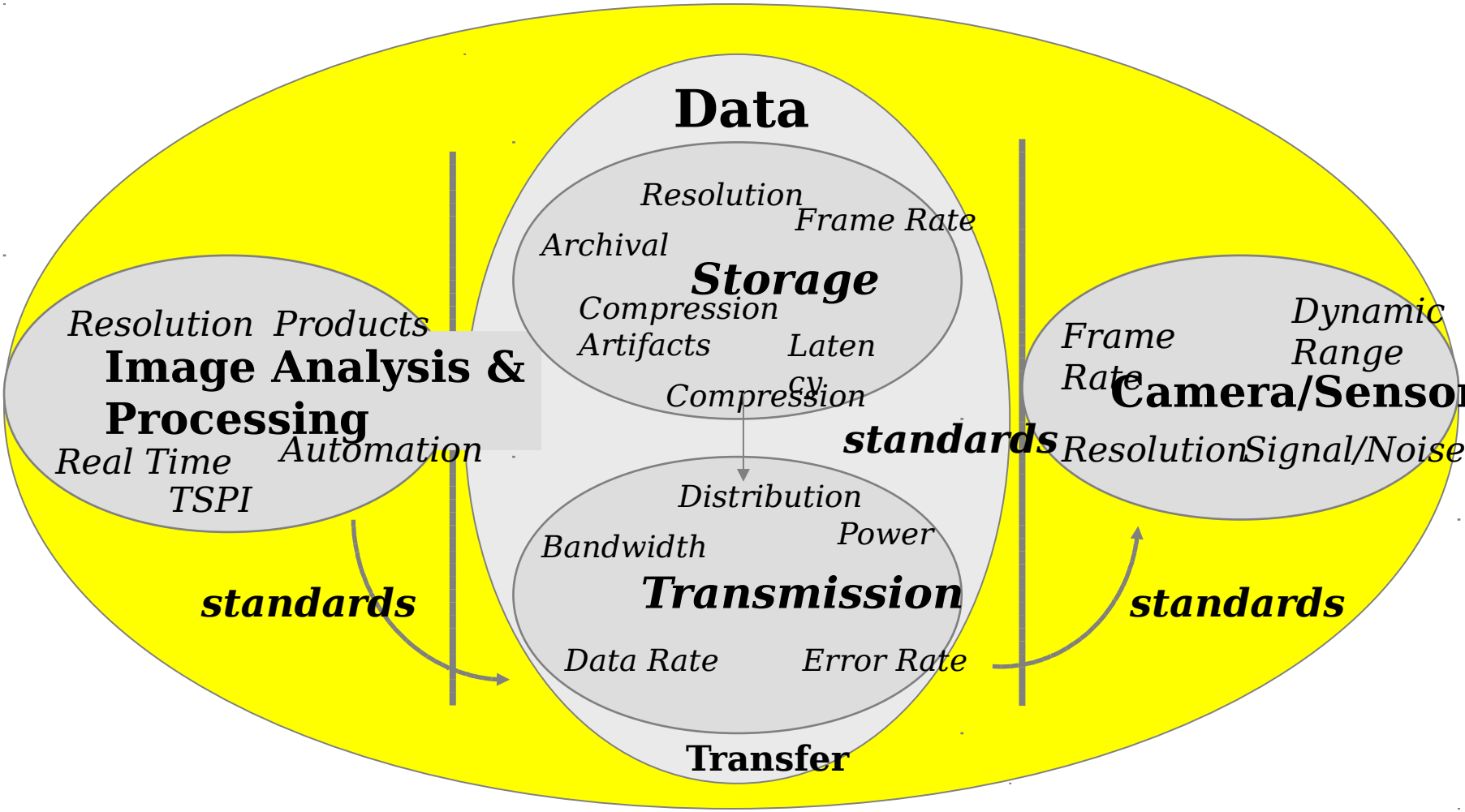
Critical Operational Issues

- **Technology Requirements**
  - **Sensors and cameras** – What do the ranges really need? Photometric requirements? Dynamic Range? Spectrum? Etc.
  - **Data** – How should the ranges handle the enormous quantities of data generated?
    - Local storage? Distributed remote storage? Etc.
  - **Analysis** – How do we make best use of the digital data collected?
- **Operational scenarios?** Distributed? Local? Remote?
- **What is technically feasible?**
- **What is practically achievable?**

Digital Video Issues

- **Bandwidths (8 - 1500 MBytes/sec)**
- **Formats (Analog, RS-422, LVDS, ECL, Fiber,etc.)**
- **Lack of Standards (High Speed DV)**
- **Storage Requirements**
- **Cabling / Data Transfer**
- **Meta-Data (Time Tagging, Gimbal Angles, etc.)**
- **Classified Data Handling**

System Engineering Issues

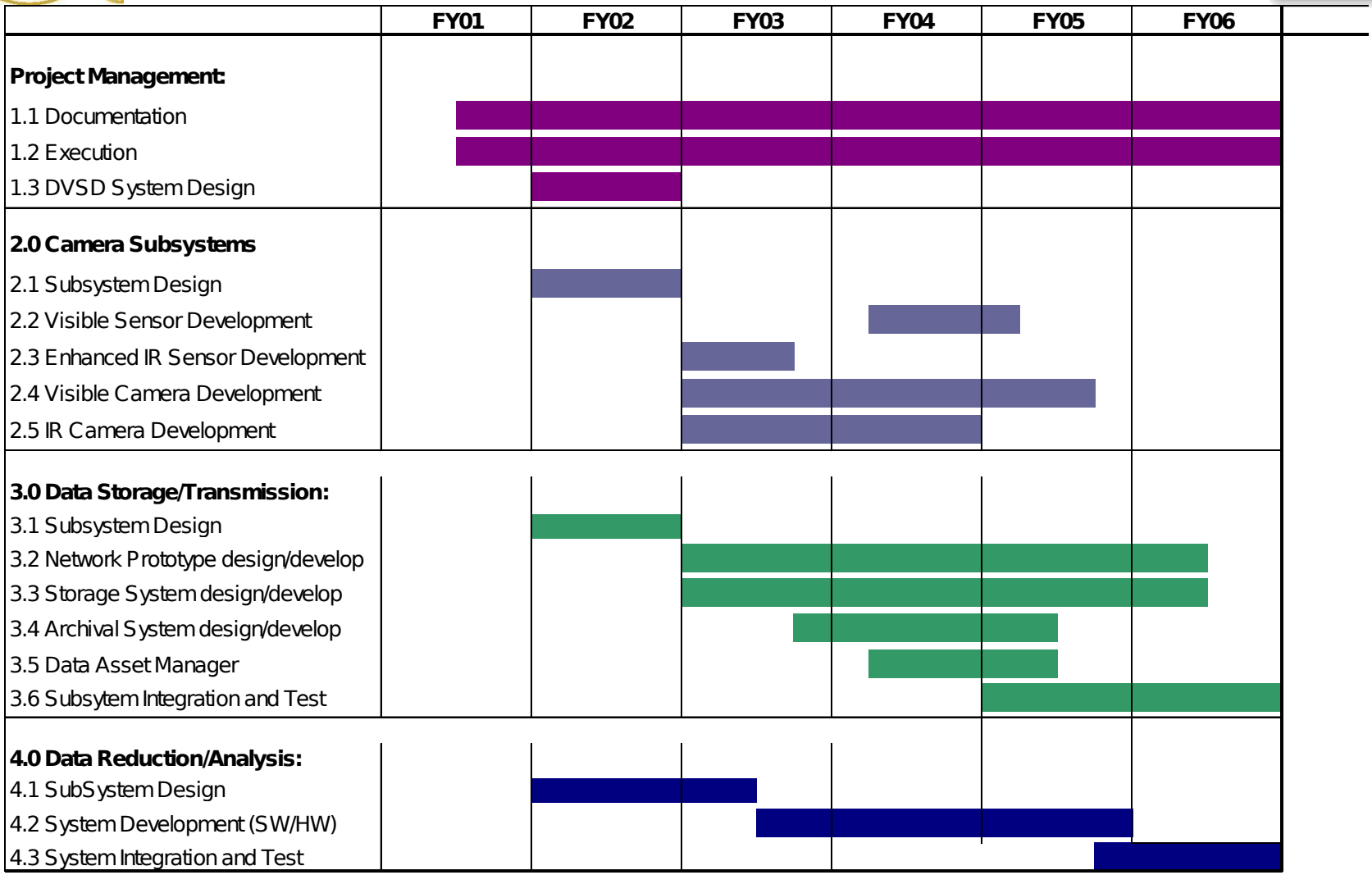


Critical Technical & Operational Parameters

- **High Resolution Sensors: 0.25 - 16 Megapixel w/EFF Cap**
- **High Framing Rates: 24 - 10,000 FPS (@ Full Resolution)**
- **VISIBLE and IR (3-5, 8-12) Sensor Arrays**
- **Dynamic Range: 10-bit or greater**
- **Sensitivity: 1 Lux/V-sec**
- **Embedded Timing/Synchronized Operation**
- **Scalable Architecture**
- **500-1000 GByte/Mission Storage**
- **1 GByte/Sec/Camera Data Transfer**
- **Digital Analysis Tools (TSPI, Image Enhancement,**

Digital Video Systems Development

Schedule



SUMMARY

- **OSD Funded Major Instrumentation FY 02 New Start**
- **Will Push Performance Envelope in Key Areas:**
  - **Image Capture (Cameras/Sensors)**
  - **Data Transfer (Cables, Fiber Links)**
  - **Data Archival/Analysis (Workstations, Editing Tools)**
- **Will Capitalize/Leverage/Build Upon Tri-Service Project Base:**
  - **ASV - Navy**
  - **DVL - USAF**
  - **HSMM/SBIR - Army**
- **Will Capitalize Upon Commercial/Entertainment Industry Advances Where Possible**
- **Overall Low/Medium Technology Risk**